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FIRE MANAGEMENT NOTES

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FIRE MANAGEMENT NOTES

An international quarterly periodical devoted to forest fire management

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California Fires 1977

Wildland fires burned thousands of acres in California and other western States this year in what has been described as one of the most severe fire seasons in recent history. The cover photograph, taken on the Hog Fire, illustrates the team-work necessary to control wildland fires. The lead article and the second article in this issue relate the enormous proportions of the 1977 fire season in the West. Watch for additional articles about the 1977 season in the next issue.



Man-caused forest fires! . . . Ack!!
Forest fires can be prevented . . .
by you!

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Bob Bergland, Secretary of Agriculture

John R. McGuire, Chief, Forest Service

Henry W. DeBruin, Director, Aviation and Fire Management

J.O. Baker, Jr., Managing Editor

Fire and Drought: Bad Mix for a Dry State

Douglas R. Leisz and
W. A. Powers

From July 23 through the middle of August 1977, California had its worst period of fire activity in recent history. In addition to the normally occurring severe burning conditions, the second year of drought in the West produced huge volumes of exceptionally dry fuels as well as short water supplies. Timber areas in the northern part of the State showed much strain from the dry conditions, with additional tree mortality. The first year of the drought (1976) prompted the fire management staff of the Forest Service's Region 5 to seek emergency funds from Congress and make ready emergency action plans. In 1976, prevention work was carried out with a new gusto, and it paid off, with only 19,807 acres of land under Forest Service protection being burned—compared to the 5-year average of 96,803 acres burned.

Well before the "official" beginning of the 1977 fire season, the Region's fire management staff anticipated a critical year, and supplemented the Region's planned fire efforts by \$5 million. The money was used for contracting three additional air tankers to supplement the existing suppression forces. Later,

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two more were added, bringing the total Forest Service air tanker strength to 17. Other preparedness measures were instituted as well. An interagency simulation exercise was conducted to test fire emergency coordination between several firefighting organizations in the State. Nationwide mobility of fire

suppression forces was activated. Normal manning of stations and seasonal positions were filled to provide coverage earlier than usual. New aircraft communication equipment was installed to provide better control and use of the air attack force.

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FIRE AND DROUGHT

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Fire Prevention

The fire prevention effort, as in 1976, seemed to be reaching a concerned public. From January through June of 1977, a little over 7,000 acres of Forest Service protected lands had burned. Man-caused fires numbered only 1,008 at the end of June—less than the average number of fires for the first 6 months of the year and far less than the average burned acreage expected for this same time period.

July started positively from a fire prevention point of view, and it seemed that fire prevention might be the key to producing a second remarkable year in keeping burned

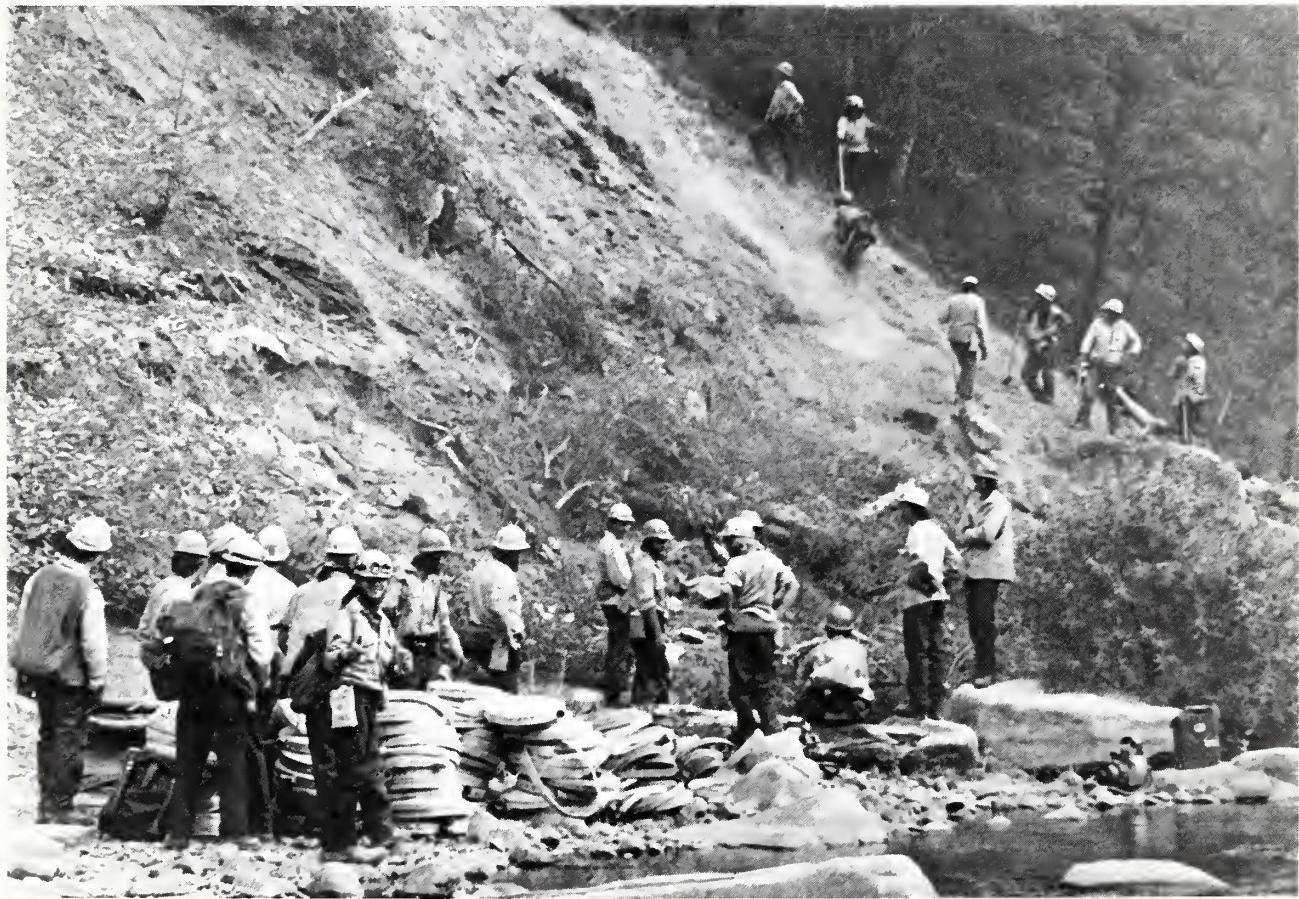
acre losses to a minimum. A concerned public was responding, and a "thank you" was in order. Whether because of the drought, water rationing, news coverage, or the vigorous prevention campaigns by fire agencies in California, the public had been exceptionally careful in the woods.

The U.S. Department of Commerce National Weather Service weekly drought calculations were made using the Palmer Drought Index. The indexes recorded in most of California were the lowest on record for that area. Extra fire danger rating measurements were added into daily fire load indexes, using a measurement of fuel types larger than 3 inches to accurately judge the effects of long-term drying of the forest fuels. The new measurements were effective in reevaluating daily manning schedules.

Activity Increases

Then, on July 23, a series of man-caused fires occurred in the south end of the State, and everyone was back into heavy suppression activity. "Hot Shots," tanker crews, and Forest Service regulars were kept busy as the Middle Fire on the Angeles National Forest burned 3,800 acres. On its heels, the Noblett Fire burned 1,150 acres.

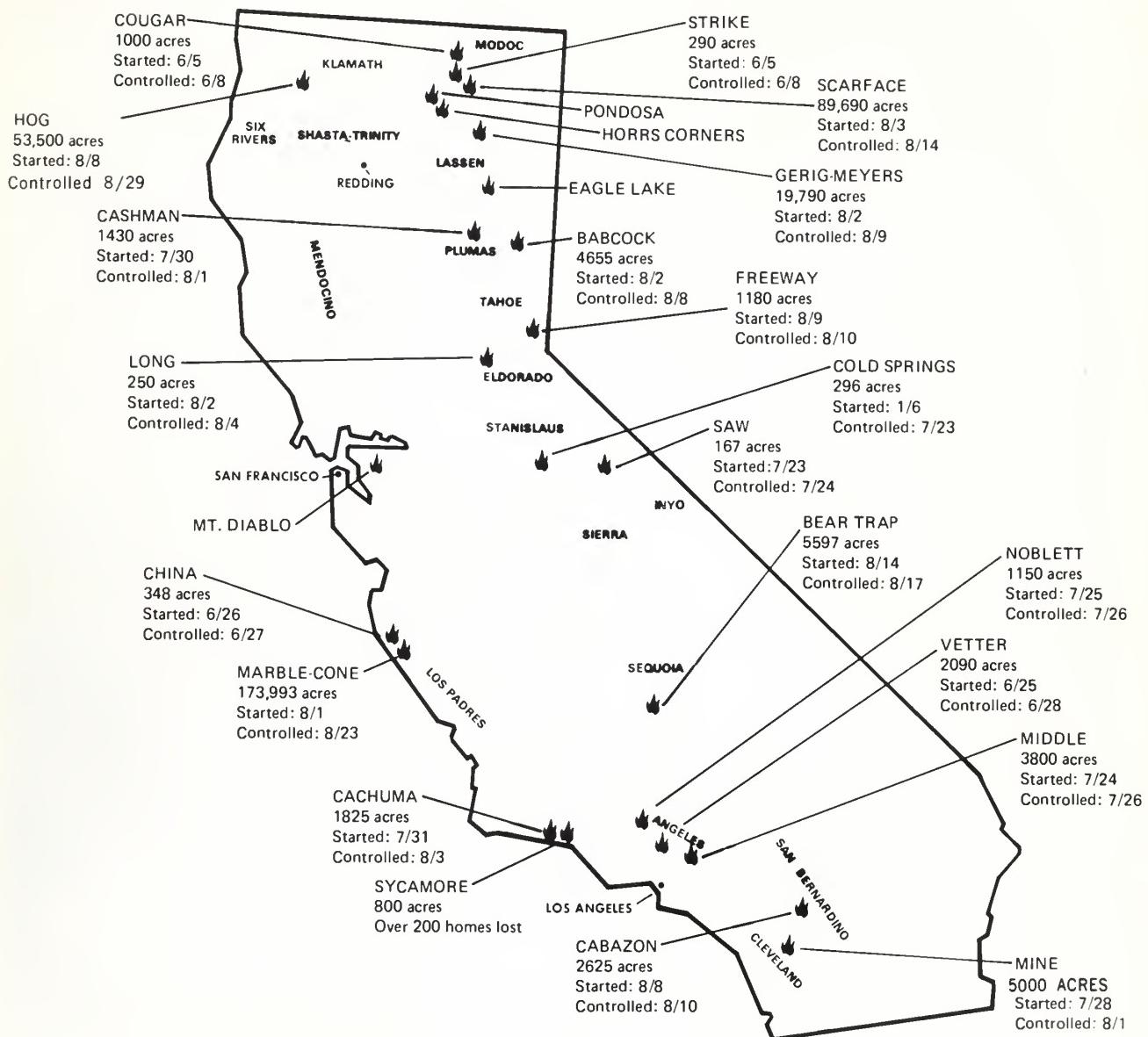
A second flurry of fire activity went through the State. A fire skirted along the edge of Santa Barbara. Over 200 homes were burned, but miraculously, no one was killed. Before that campaign was over, the firefighters on the Cleveland National Forest saw the Mine Fire get as large as anything yet in the season. That fire was finally controlled at 5,000 acres. Some of the causes of these



One crew waits to move hose up a fireline being completed on the Hog Fire to the North Fork of the Salmon River. Water was to be pumped up the hill in stages.

MAJOR FIRES IN CALIFORNIA

THROUGH AUGUST 30



fires were illegal tracer ammunition and illegal campfires in closed areas. The pattern was all too familiar.

Two large fires brought reality to Bay Area residents. Fires in the Napa Valley and on Mt. Diablo showed people the grim and visible reality of extreme conditions the drought had spawned.

Most of the California's initial attack forces were on active project fires when a massive, Statewide dry lightning storm crossed California, leaving in its wake more than 240 fires. The worst had happened!

The tired forces were often dispatched directly from one fire to the next with no rest. Dispatchers sent

large numbers of people and equipment to all parts of the State. The forces did a remarkable job in suppressing most of the fires, keeping all but a handful at less than 10 acres. But in a few inaccessible areas of the State, six or seven fires had burned together.

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FIRE AND DROUGHT

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The fire, named Scarface, burned 89,000 acres in Modoc County after four smaller fires had merged. The Gerig-Meyers Fire, within 20 miles of the Scarface, burned another 20,000 acres. The Hog Fire on the Klamath National Forest claimed 57,500 acres of timber before it was finally controlled. But the Los Padres National

Forest received the most notoriety when two huge blazes burned together and became the third largest fire in California's history. The Marble-Cone Fire burned 174,000 acres, mostly in the Ventana Wilderness. It was out of control for 18 days!

By the end of the siege 344,000

acres of wildlands protected by the Forest Service were scorched by fire. These accounted for most of the 410,000 acres burned within the State. All but 8,000 of these acres had burned after July 23. The forces of nature had dealt a severe blow.

The safety record was exceptional, considering this highly hazardous work. Aggressive suppression action did occur, but safety was obviously the first priority. In past years, under similar conditions of long hours of fierce fire suppression work in extremely difficult terrain, the incidence of injuries and fatalities had been high. This year, although many minor injuries, such as bee stings and cuts and scrapes, plagued the crews as usual, serious injuries and fatalities were few.

A warm thank you is extended to all the people who helped in California's month of trouble. The combined efforts of the men and women who fought fires in California resulted in control of these conflagrations. A true feeling of unity emerged when the main campaigns were over. New friends had been made, and everyone learned much about cooperation.

During the final days of August fire business activities wound down to a near standstill. Just 30 fires were reported in the last week of the month, with only one burning more than 9 acres.

Looking Back

Looking back over the summer's fire activity, the fire prevention program had been a success despite the end losses. A stronger public involvement campaign was implemented and resulted in new ideas, new friends, and closer cooperation of those involved. Special fire restrictions were applied to most areas in coordination with other agencies and affected users. Only a few complete closures were necessary. Fire restriction and fire prevention information



It was necessary to conduct extensive burning out operations in order to contain the 174,000-acre Marble-Cone Fire.



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Continued on page 16

Smoke and fog kept air tankers grounded for all but a few days on the Marble-Cone Fire.

added to the weekly telephone and radio messages about water supplies and fire danger. Press coverage, on a new program using infrared surveillance during the first of the hunting season, proved that the news media was taking notice of fire prevention where there had been little interest before.

New ideas are being added and are working. Old ideas are being revitalized and are maintaining a strong basis for increased efficiency and improvement. All the actions form a very positive fire prevention program for the Forest Service and other agencies in California, and the future looks bright for continued success. 

Forest Fire Shelters Save Lives

Ernest V. Andersen

June 17, 1977, 2:30 p.m. A tractor boss and two tractor operators are overrun by a fire in New Mexico. The running fire cuts off their escape route¹. . . .

July 26, 1977, 10:30 p.m. A three-member fire engine crew is trapped on a fire in central California. Their escape route is closed by heat and flames

August 14, 1977, 3:00 a.m. A crew of 20 experienced firefighters is outflanked by a fire in northern California. The running fire burns directly around and over them¹. . . .

They all survived! The common denominator contributing to the happy endings of these documented circumstances is the fact that all the individuals involved carried and used forest fire shelters. In three cases, those involved believe the use of forest fire shelters prevented injury and saved lives.

A Brief History

Forest fire shelters were first generally available in the United States in 1968. Shelters were developed at the Forest Service Equipment Development Center (MEDC) in Missoula, Mont., after an intensive testing program. The first designs were coordinated with work done in Australia by Dr. Allan King.

Continuing work at MEDC has re-

¹ Documented accounts of shelter use, in the form of witness statements, are on file with the Aviation and Fire Management Staff, Forest Service, Washington, D.C.



Figure 1.—The current model shelter in its carrying case weighs only 2.8 pounds. The reduction in bulk and weight from the earlier model was accomplished by removing the shelter liner. Effectiveness was not reduced.

sulted in reducing the bulk and weight of the shelter from that of original models. The current model weighs 2.8 pounds and measures $5\frac{1}{4} \times 2 \times 11\frac{1}{2}$ inches when properly folded and packed (fig. 1).

Uses

Shelters were designed to provide personal protection in emergency situations when inadequate intelligence or unpredicted conditions result in firefighters being trapped in

wildland fires. They were not designed to provide for noncompliance with proven safety practices or policies. They should not be used to extend the firefighters into highly dangerous work environments.

Training in shelter deployment and use is extremely important. While it

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Figure 2.—The shelter is removed from the carrying case.



Figure 3.—The shelter is entered while the user is in an upright position.



Figure 4.—The user lays face down with the shelter over her.

might take several minutes for an untrained individual to deploy and occupy the shelter, experience has shown that with three or four trials, this can be reduced to 20 to 25 seconds. Shelters used for training purposes should be specially marked and should not be carried to the fireline.

In two of the three cases described above, the shelter users had received training in the use of the shelters 48 hours or less before their use. These firefighters believe the recent training was a factor in preventing panic.

A 17-minute 16-mm color training film, "Your Way Out," discusses and demonstrates shelter use. This film is available from the National Audiovisual Center (NAC) of the General Services Administration (Order Section), Washington, D.C. 20409.

The film is NAC Catalog number 003796 and costs \$98.50. Viewing the film, followed by repeated trial deployments of the shelter, is recommended for all potential fire shelter users. This training and testing may also provide the psychological boost necessary for individuals to trust and depend on the shelter if compliance with standards and practices fails to provide adequate protection.

Availability of Shelters

Forest fire shelters and carrying cases are available from General Services Administration. The GSA catalog number of the shelters is 4240-01-017-7869. They cost \$11.30 each. The fire shelter case is catalog number 8465-01-003-4081 and costs \$2.25 each.

Future

Opportunities to further develop and improve the shelter will be sought in the future. The present shelter, deployed and used at the right time and in the right place, can be a life saver! The record proves it!

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Automatic Transmission of Fire Weather Data by Minicomputer

Robert S. Helfman

Automating the sensing and transmission of fire weather data is a problem in economics, design, and technology (Maxwell and others 1974). One problem is that in any automatic system, data gathered from a specific network are usually recorded and displayed at the central site but are not readily available to other users and to remote sites. To date, none of the systems developed has successfully automated the dissemination of data from a single agency system to a broader multiagency network.

Another problem is that most fire weather reporting stations are manually operated. The data are entered in the Forest Service's national network called AFFIRMS (Administrative Forest Fire Information Retrieval and Management System) (Helfman and others 1975). This time-sharing computer transmits fire-danger data to several hundred interactive remote terminals throughout the United States. The weather data are, however, manually entered. For a system to be truly automatic, both the sensing or observing and transmission of data must be done entirely without human intervention. Therefore, data from automatic stations and manually entered data would need to be integrated so that both types are avail-

able to users throughout a network.

The problem of interfacing automatically and manually reported weather data will become more pressing as additional automatic fire weather stations are introduced. Development of interface technology requires a substantial expenditure in simply acquiring a small network for testing. Since the Forest Service's Meteorological Research Telemetry Network (McCutchan 1975) had been operating successfully for several years in the mountains of southern California, it was a natural candidate for this development work.

We undertook interfacing of this network's data into two remotely located computer systems: (1) the IBM 360/50 system at the University of California's Riverside campus, and (2) the General Electric Mark III system, in Rockville, Md., on which AFFIRMS is implemented. Riverside is the site at which we would like to achieve our network data to form a data base for further meteorological research. Its proximity would facilitate software development with minimal communications problems. Entry of our network data into AFFIRMS would make it available both to nearby National Forests and to the National Weather Service Fire Weather Forecasting office in Los Angeles, which currently has no access to micrometeorological data from the mountainous areas of southern California.

Approach

The Meteorological Research Telemetry Network was originally controlled by a Data General Corporation Nova 1200 minicomputer, equipped with 24,000 words of core storage, a real-time internal clock, external calendar clock, and a low-speed industry nine track tape drive. This configuration operated under Data General's Real Time Operating System (RTOS) and involved no disk storage. Data were recorded on tape for subsequent processing on larger computers.

An analysis of the original network software showed that most of the minicomputer's time was spent in simply checking for impending station polls. This led us to conclude that a modest increase in equipment on the minicomputer would permit us to transmit data directly to other computers without degrading network performance.

We added another 8,000 words of core storage, a disk drive, and synchronous communications equipment to the Nova 1200. In addition, we installed a special control that would permit the minicomputer to "dial" remote telephone numbers and establish data communications without human intervention (fig. 1).

We began developing a series of modular computer routines that would be sufficiently general in structure so that they could be used to interface with several different re-

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remote computers—each having its own requirements for incoming jobs.

The network control program used in the minicomputer was extensively modified to permit storage on disks of an accumulated file of network data as the data are gathered from the remote weather stations, and also permit storage of data on magnetic tape as in the original system. Provisions were added so that the network control program (NETCON) would relinquish control of the minicomputer at a specified time of day to another program, the automatic data transmission system (DATAEX).

DATAEX transmits at 11:35 p.m. local time. This is a compromise

among several factors that depend largely on the job load at the computer center to which we are transmitting data. DATAEX "dials" the remote computer, establishes data communications, and proceeds to send network observations and the job control information. Once the data are transmitted, DATAEX waits for job status information to be returned from the remote computer. When assured that the data were successfully sent, DATAEX empties the accumulated disk file of network observations to prepare for a new day's accumulation. All network data are also recorded on magnetic tape, but need never be used unless a failure

at the remote computer prevents the transmitted data from being successfully processed and achieved.

DATAEX then returns control to NETCON, which returns the network to precisely the same configuration of polling intervals, station, and sensor status that it had previously. The network takes about 12 minutes to transmit an entire day's data when it is operating with a 10-minute polling interval. In the more typical case of a 30- or 60-minute polling interval, only a few minutes are needed for the transmission.

In the event that the remote computer called fails to "answer" the

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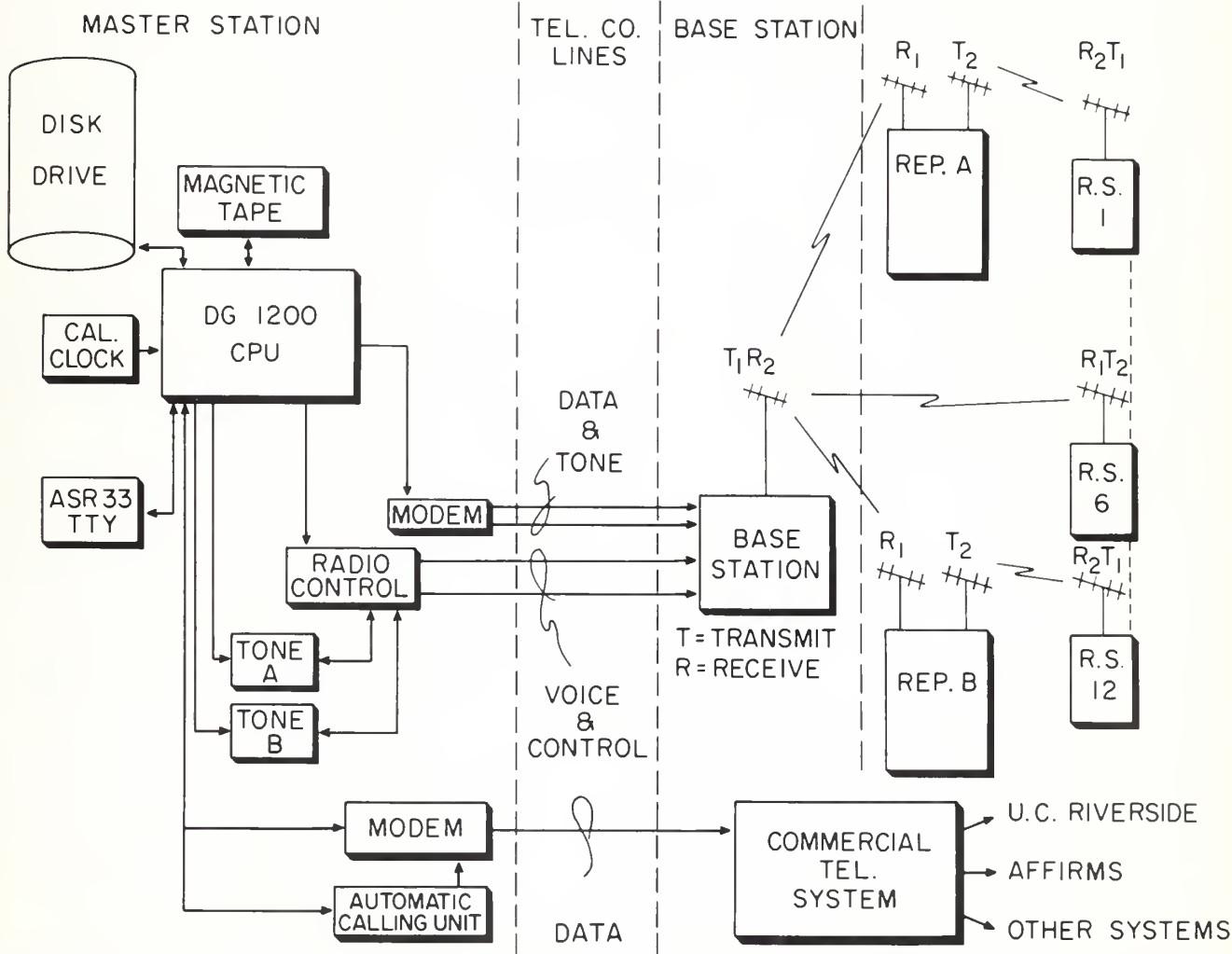


Figure 1.—A minicomputer automatically transfers data from telemetered weather stations to a network and other computers over a dial-up telephone system.

AUTOMATIC TRANSMISSION

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call, the minicomputer simply retains the accumulated network data until the next night, when it attempts the call once again.

This system has been operating for several months, and is now the routine method by which our research network data reach the University of California at Riverside.

Interface to AFFIRMS

Development is now complete on similar programming required to transmit data directly into the AF-FIRMS network. This work has involved two major problems:

1. Automatic stations, such as those in this research network, do not record all of the information needed by AFFIRMS in a fire weather observation. Certain man-measured items, such as lightning activity level, man-caused risk, and fuel-stick moisture, have to be obtained from a nearby station that records data manually. AFFIRMS has been modified to allow association of a manual station with each automatic station, so that the manual station's data are used as necessary to fill in gaps in the automatic observation.

2. Timing of data entry from automatic stations must be synchronized with that from the associated manual station so that the manual station observes first. Data from automatic stations at the regular fire danger rating time (usually 2 p.m.) will be entered into AFFIRMS as normal observations (OBS) and those at all other times will enter as "specials" (SPC). Area forecasts entered into AFFIRMS by the fire weather forecasters will apply to the automatic stations without any change in programming or procedures.

Future Applications

The technology described here is applicable to many data transfer problems.

One application, on which work is now beginning, involves use of the minicomputer to obtain upper-air numerical (LFM) forecasts from the National Weather Service (through the U.S. Bureau of Reclamation's Denver computer facilities) and send them to another computer for use in toposcale temperature and wind models.

A second application would provide the means by which data from remote fire-weather telemetry platforms, which transmit by way of the Geostationary Operational Environmental Satellite (GOES), could be distributed to many users. A minicomputer could be "dedicated" to full-time operation as a data transfer system, accepting fire weather data from the GOES computer, making appropriate calibration computations, and subsequently calling into AFFIRMS to make the data accessible to anyone with a terminal.

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Smokey Says:



IF... is one of our saddest words
... "If I just would have been
more careful". Human carelessness
causes most forest fires... please
watch out!



Helicopter Rappelling

Paul Hart

The fire had all the ingredients for another catastrophic burn on the Wenatchee National Forest in Washington State.

It began within easy viewing distance of a vast area that burned in the lightning bust of 1970, when 131,000 acres had gone up in smoke. It began on a very high hazard day, well into a summer of prolonged drought. It burned in an unroaded area and was pushed by 25-mile-per-hour winds.

Yet this fire was stopped at mid-slope. Although it had the potential to burn many thousands of acres, it burned only 512. What stopped it? Aggressive attack and well-balanced firefighting forces, to be sure.

"But it was the rappellers that really saved our bacon on the Box Canyon Fire and many other fires this summer," said John Rogers, Supervisor of the Wenatchee National Forest. "The Box Canyon Fire was a team effort—retardant ships, rappellers, jumpers, and 'ground pounders.' But we couldn't have done it without the rappellers."

Forest Service Rappelling Unique to Region 6

Forest fire rappelling in the continental United States is unique to the Forest Service's Region 6—Washington and Oregon—right now. Programs are operational in Canada (a model

Continued on next page

Mr. Hart is the Public Information Officer on the Wenatchee National Forest at Wenatchee, Wash.



Helicopter rappellers scramble to a fire in Washington State. The helicopter is airborne and headed for a fire within an average of five minutes from the time an alarm is received.

HELICOPTER RAPPELLING

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for the early region 6 program) and in Russia as well.

Rappelling is a technique developed by rock climbers for descending rocky terrain on long ropes. By adapting the technique to helicopters, a process has evolved for placing firefighters beside fires in rugged or remote terrain that might otherwise take many hours to reach.

Box Canyon Fire

Consider the Box Canyon Fire, for instance. It was an escaped campfire that started at 3 a.m. from the 1,100-foot elevation on the unroaded south shore of 50-mile-long Lake Chelan. The 110-percent slope, where it burned, rises to 5,500 feet. The flames, fanned by a strong downlake wind, pushed toward recreational developments and spread through drought-parched grass and brush and into pockets of pine and fir.

By daylight the fire, pushed by a 20-mile-per-hour wind, had burned 200 acres. There were no roads; the slope was too steep to land a helicopter; winds and terrain were too difficult for a direct smokejumper drop. Yet within minutes 18 rappellers were carving handlines to flank the fire, and then cutting off channels of fuel that reached between rock outcroppings to heavy timber above.

Retardant drops accompanied the initial attack, smokejumpers dropped to a wind-protected area on the far shore of the lake and were carried by boat to the fire. Reinforcement forces were boated uplake to join the attack. Within 22 hours the fire was contained.

Rappelling Equipment

The basic elements of this rappelling operation were a Bell 212 twin engine helicopter, a pilot, a six-member rappelling crew, a spotter, two 250-foot ropes, and six descent control devices.

The control device, a metal cylinder that slides on a rope and attaches to the rappeller's harness, is marketed under the name "Sky Genie." It is an adaptation of equipment developed for window washers that permits the rappeller to control his rate of descent. The ropes are $\frac{1}{2}$ -inch braided nylon capable of holding up to 5,000 pounds.

Rappellers wear a helmet and a simple flight suit of fire retardant cloth over standard firefighting gear. A harness secures the rappeller to

the descent device, and the rope is anchored to the ceiling of the helicopter. Total cost of a rappeller's gear is about \$180.

Most of the equipment used by rappellers was designed and improved during the first 3 years of the program, according to Terry Lesmeister, foreman of the Chelan Base, who has been with the program from the beginning. "The goal with all this equipment has been to build a wide margin of safety into the program," he said.



Rappellers slide two at a time from a hovering Bell 212 helicopter. The maximum rappel is 240 feet in winds up to 35 miles per hour.



Packing firefighting gear, a rappeller heads home following a training rappel. Rappellers often must hike out of the backcountry to the nearest road.

"In fact, the main element of the program has been safety all along. We all knew that if there were any serious injuries, it could mean the end of the program. We think we have proved that this is a very safe way to initial attack forest fires."

The sixth year of rappelling has now been completed in Region 6. The first 4 years were used as a study program, and the last 2 years were used as an operational program. The study program was conducted with two 20-person rappelling bases—one at Redmond, Oreg., and one at Chelan, Wash.

This year there were rappelling bases at Grants Pass and Detroit in Oregon and at Snoqualmie Pass and Chelan in Washington.

Results Speak for Themselves

The results of six summers of rappelling in Region 6 speak for themselves. There have been 7,300 rappels—6,162 in training and 1,138 to fires—with no injury accidents.

Is rappelling really needed in a Region that already has an effective broad-base firefighting organization that includes well-trained ground

crews, smokejumpers, retardant aircraft, and helicopters?

"Rappelling is filling a void that we haven't been able to fill in the Chelan District," says District Ranger Bob Hetzer. "More than 60 percent of this 368,000-acre District is unroaded. It has incredibly rugged terrain with flashy fuels mixed in with heavy stands of timber."

"We have a lot of country where helicopters can't land and jumpers can't jump safely," Hetzer added. "We often get heavy lightning activity, and high winds are common. We can't afford to take a couple of hours to get people on a fire. If we don't get our fires when they are small, we can plan on a major project fire."

The fire record on the Wenatchee National Forest, during this summer of the worst drought in history, supports the philosophy of aggressive initial attack. There were 316 fires—140 man-caused and 176 lightning-caused. Total acres burned: 988.

Rappelling is effective in tall timber with a closed canopy and with tree heights up to 240 feet—spots where jumpers might get hung up. It can also be done in extremely rugged terrain and in winds up to 35 miles per hour.

Personal Requirements

Rappellers should have a solid background in firefighting before they enter the program. "Our people are doing initial attack, usually in very difficult terrain," Lesmeister noted. "They have to know how to fight fire, and they have to understand fire behavior."

Beyond this, rappellers must be in top physical shape. Not only must they suppress a fire, but, like the smokejumper, they often must hike several miles cross-country to get out of the woods. They will be packing equipment weighing up to 80 pounds.

Because of the rigorous physical requirements, rappellers generally have been men, though two women participated in the program at Chelan

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HELICOPTER RAPPELLING

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last summer. "It takes exceptional dedication and commitment to be in this program," says Dean Hortin, Chelan District Fire Management Officer. Yet the annual turnover of rappellers is slight.

Versatility a Virtue of the Program

One of the virtues of the rappelling program is its versatility. In attacking a fire, the helicopter can land and unload rappellers, helitack-style, whenever possible. Often this is not possible. All six rappellers can be dispatched to a single fire, or they can be spread out to several fires. Once the rappellers are deployed, the helicopter can be used for water drops or other support activities.

The rappellers themselves have a wide variety of expertise—from tree felling to heavy equipment operation to heliport management. When not fighting fires, they lend their support to various fire management projects, including residue reduction and construction of backcountry helispots.

Beyond this, the rappelling crews are an interregional suppression resource available to assist anywhere in Region 6 or anywhere in the country in critical fire situations. Last year, a 20-member crew fought spot fires around a major fire that scorched inaccessible bogland and forests in Michigan. This summer, rappellers from four bases joined forces to help combat a massive lightning bust in eastern Washington.

Rappelling is not a replacement for other firefighting tactics, like smokejumping, Hortin emphasized. "This is a supplement to the attack program. It is another tool we can use to do a more effective job of fighting fire."

There has been close contact between the designers of the rappelling program and the smokejumping directors. Indeed, some of the training for rookie rappellers has taken place

at the North Cascades smokejumper base at Winthrop, Wash. "From my standpoint, it would be ideal if the jumpers and rappellers were cross-trained so they could handle either job when we need them," Hortin said.

Beyond this, the Wenatchee National Forest is considering the feasibility of cross-training selected members of initial attack or interregional crews as backup for multiple fire situations.

Cost has always been a limiting factor in the expansion of the rappelling program, though Region 6 studies show the program to compare favorably in cost with the helitack and smokejumper operations. Still, the costs are significant. This year the cost of the helicopter, pilot, and ground support ran \$2,088 per day and \$375 per hour for flight time. The total for the summer was \$292,000.

Yet the cost of suppression alone on the 1970 fires on the Wenatchee National Forest was \$13 million. "Of course, it is impossible to forecast the potential costs of wildfires in a given year," said Supervisor Rogers. "But this is a high hazard Forest every summer, and we believe the rappelling program is very cost effective."

Rappelling has been cleared for use Forest Service wide, but whether it will spread to other Regions remains to be seen. Region 1 of the Forest Service has sent people to Region 6 to learn more of the program, exploring possible future adoption of the program.

There has been some skepticism about the safety and effectiveness of the program, and the rappellers and managers are working to overcome those concerns. Within 6 years they have compiled an impressive list of successes, without injuries.

People on the Wenatchee National Forest think it is an effective suppression method with an important future in fire management.

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Put the Water Where You Need It

Charles Petersen

Fire managers have long recognized the value of having water readily available on fire and fuel management projects. The problem has always been getting water to the projects in relatively short periods of time and in quantities of sufficient volume to be effective.

Reservoir Fabricated

In 1974, the Canyon Ranger District on the Clearwater National Forest in Idaho developed and began using a portable aluminum water reservoir. The tank sides and bottom are constructed of $\frac{1}{8}$ -inch #6061 aluminum. It is 6 feet deep and 8 feet in diameter with a capacity of 2,255 gallons. Box-type bands of $1\frac{3}{8}$ - by 3-inch channel aluminum are attached around the top and bottom of the tank for structural rigidity and to provide the necessary protection during transport.

The tank has one 3-inch and two 2-inch outlet/inlets that can be used in any of several combinations of filling, emptying, dipping, pumping, and gravity flow systems.

Air Transportable

Four sling attachment points are welded around the top of the tank to attach the 25 foot, $\frac{1}{4}$ -inch four-part sling. The length of the sling allows a helicopter to land beside the tank and hook up for aerial transport.

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The tank and sling apparatus, ready for flight, weighs 430 pounds. This is nearly a maximum load for a small helicopter such as a Bell B-1 or B-2. If larger ships, such as a Bell 206, are being used, the filler pump, Sim's-type water drop bucket, and tank accessory kit containing tools and adapters can all be placed in the

tank and transported at the same time.

Since aerial delivery is not always desirable, the tank can be loaded on a long-bed pickup truck, secured in place, transported, and unloaded at the desired location by two men.

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The reservoir can be transported to remote parts of the fireline by helicopter.

A Wheeled Blower for Building a Fireline

James S. Lyon

Since the late 1950's, the Missouri Department of Conservation has been involved with the development of a lightweight wheeled blower for fighting wildfires in southern Missouri (Nichols and Pallsell 1959). Since the blower was first described in 1959, it has been improved so much that it is now becoming a standard firefighting tool on Missouri's State fire districts.

Missouri has three different types of vegetation that are subject to fire: hardwood or pine-hardwood forest, range land, and brush. All three of these vegetative types may be encountered on a single fire, and suppression methods must take this into account. Brush is usually the most difficult fire suppression problem since it is often a mixture of grass, shrubs, juniper, vines, and hardwood sprouts.

Description of Blower

The blower consists of a frame supported on two 20-inch bicycle wheels. The wheels are offset in order to clear the air outlet and maintain balance (fig. 1). The only operator controls are a choke and a throttle. Mounted on the blower frame are a fuel tank, an engine, and a fan. The fuel tank holds 1 gallon, and is vented through a plastic tube

Mr. Lyon is a Forestry Aid on the Cajon Ranger District, San Bernardino National Forest at Fontana, Calif. He was previously employed in Rolla, Mo., by the Missouri Department of Conservation as a towerman.



Figure 1—The blower at rest (1975 model). Note the fuel tank vent tube and the gravel that was moved by the air blast. (Photo by Missouri Department of Conservation).



Figure 2.—Building a fireline in hardwood litter. The blower is a 1965 model. (Photo by Missouri Department of Conservation.)

on the operator's handle instead of the normal hole in the filler cap. This is done to prevent vented fuel from being ignited.

The 8 hp, two-cycle engine operates at 6500 r/min. A two-cycle engine is needed not only because it is lighter and faster than a similar four-cycle engine, but because it will not develop lubrication problems when used on steep slopes. The 12-inch diameter fan is a centrifugal type and is connected directly to the engine. The air outlet is aimed at the ground at a 45° angle and is normally 5 to 7 inches from the ground. Since the blower weighs only 73 pounds, it can be lifted by one person.

The relatively light weight and low center of gravity allow the blower to be used on fairly steep slopes, up to a maximum of about 40 percent. Its effectiveness, however, decreases steadily on slopes of more than 30 percent. On 30 to 40-percent slopes, the backpack blower is more useful

than the wheeled blower (Welsh 1965).

Methods of Use

The method used to build a fireline with the wheeled blower in hardwood or pine-hardwood timber depends on the number of crew members, the width of line needed, and the condition of the leaf litter. The blower has been used successfully in pine plantations, but not enough experience has been gained in this fuel type to prove its effectiveness for building a fireline in pine duff.

In the preferred method for deep, matted leaf litter, the operator pulls the blower behind him while scuffing up the litter with his feet. If a wider line is needed he moves 40 or 50 feet forward in this manner, and then turns around and works back with the blower offset somewhat from the original line. On the third pass back up the line the operator pays special at-

tention to any remaining uncleared spots. If another crew members is available, he assists by removing branches and other debris from the line. In shallow, loose litter, one pass of the blower will often build a line down to mineral soil of sufficient width to stop most surface fires (fig. 2).

For direct attack on a fire in woods, grass, or brush, the air blast of the blower is aimed at the base of flames so that loose and burning material is blown back into the fire. The operator works the blower forward along the edge of the fire with a back and forth motion, as if using a hand-pushed lawnmower. When used in this manner, the blower must be kept free of spilled fuel that might be ignited. It is usually necessary to have at least one other person with a fire rake or backpump follow the blower to put out any spots that are missed.

A difficulty arises when the fire is
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WHEELED BLOWER FOR FIRELINES

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Figure 3.—A woods fire that is too hot for direct attack with the blower. (Photo by Missouri Department of Conservation).

on the right side of the blower, since the air outlet is on the left. If the fire intensity is low enough the operator can pull the blower behind him and continue as above. On hotter fires the usual solution is to move some distance along the head or flank of the fire, and then come back blowing the litter to the left. Occasionally a fire

will burn so hot and fast that the blower ceases to be effective for direct attack (fig. 3).

Safety and Maintenance

Some additional points should be made about safety and maintenance of the blower if it is to give reliable

service. Filters, carburetor settings, spark plugs, and fuel lines should be checked often, and always after a fire. The blower should also be checked periodically for loose nuts and bolts. Current practice is to use more than normal amounts of oil in the fuel for the blower because of the higher r/min at which the engine

runs.

There are several advantages and disadvantages to the blower described here. The advantages are:

1. It can build a fireline to mineral soil quickly in leaf litter.
2. It is effective on grass and brush fires.
3. It allows one person to control most small or slow burning fires successfully.

Some disadvantages of the blower

are:

1. It is subject to mechanical failure.
2. It is not effective on steep slopes or in dense brush.
3. The direction of the air outlet cannot be changed.

Experience has shown that the wheeled blower provides fire crews in Missouri with greatly improved capability at a modest cost. It seems likely that the blower could be used

in other parts of the country, especially the East and South.

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PUT THE WATER

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Highly Effective System

The system has proven to be highly effective on fires that pose sizeable escape potential due to unusual fuel and weather conditions. Rapid transport and ease of set-up on a road or opening near the fire can turn a small stream into a valuable helicopter dipping reservoir in a relatively short time. This makes it possible to get large quantities of water on the fire where it's needed, when it's needed, and with less turn around and flight times.

Although the tank was primarily developed to be used as a reservoir for helicopter dipping operations, the past three seasons have shown the tank to have several other valuable functions. In areas with no available water source and no accessibility by road, fires can often be suppressed more efficiently and rapidly if water can be made available. The aluminum tank can be flown to a clearing near the fire site and filled with the needed amount of water from a nearby dipping site with a Sims-type bucket. The water can then be pumped or gravity fed to the fire as it's needed. This operation can greatly reduce the manhours spent to extinguish the fire.

Project fire camps normally require a sizeable supply of water for cooking, showers, cleaning, etc. The aluminum tank can be hauled to the fire campsite, filled, and then covered; thus releasing a tank truck for



The system is highly effective because it is easily transportable and can be used in many manners.

other duties. If this is done, special care must be taken to ensure that the water is properly treated if used for drinking.

Prescribed Burning Use

The tank also works very effectively during prescribed burning operations. It can be set up rapidly at the location where supplemental protection is needed and filled from a nearby water source or from a tank truck prior to starting the burning project. This relieves tank trucks for continuous transport of water if more is needed. It also permits the trucks to be used in other areas if unexpected problems develop. On some

prescribed burn projects supplemental protection is desired on parts of the area, but due to smoke concentrations and fire intensities during the burn, water transport vehicles often cannot safely operate. The tank can be positioned and filled, making water available without jeopardizing personnel or water transport vehicles.

The 2,255-gallon aluminum reservoir has been proven to be a highly effective and more versatile fire management tool than originally expected. It has returned, in savings, the original cost of \$1,400 many times in the past 3 years by putting the water where it's needed, when it's needed.



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